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RWI #1190

Imprint

Ruhr Economic Papers #1190

Responsible Editor: Ansgar Wübker

RWI – Leibniz-Institut für Wirtschaftsforschung e.V.

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www.rwi-essen.de

The Institute has the legal form of a registered association;
Vereinsregister, Amtsgericht Essen VR 1784

Published by

RWI – Leibniz-Institut für Wirtschaftsforschung e.V.
Hohenzollernstr. 1-3, 45128 Essen, Germany

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RWI is funded by the Federal Government and the federal state of North Rhine-Westphalia.

ISSN 1864-4872 (online)
ISBN 978-3-96973-375-2
DOI https://dx.doi.org/10.4419/96973375

Dementia Severity, Informal Caregiving and Labour Market Outcomes in Europe

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Abstract

Dementia is associated with an increasing need for care, which is often provided by informal carers. This may have an impact on their behaviour in the labour market. This study analyses the impact of dementia severity on informal care, labour market participation and working hours of informal carers. We use data from the multinational RightTimePlaceCare (RTPC) study, which covers eight European countries and uniquely links detailed information on people with dementia and their primary informal carers. Using descriptive statistics and multivariate regression models, we analyse the relationships between the severity of dementia, the intensity of care and labour market outcomes, taking into account the endogeneity of care intensity through an instrumental variable approach. Our results show that higher dementia severity significantly increases the intensity of informal care and substantially reduces both labour market participation and working hours of informal carers. These findings highlight the economic consequences of dementia care and underscore the importance of considering labour market impacts when assessing informal dementia care.

Keywords: Dementia, Informal caregiving, Labour market participation, Labour market hours

JEL Classification: J14 J22 I11

Acknowledgements

The authors are grateful to the participants of the 17th dggö annual conference, the 11th dggö workshop and the internal seminars of the RWI-Leibniz Institute for Economic Research, the Institute of Health Economics of the Leibniz University Hannover and the Institute of Social Policy of the Vienna University of Economics and Business, for their valuable comments and suggestions. The authors thank the European Consortium and Steering Committee Members for the access to the RTPC dataset, namely Prof. Dr. Gabriele Meyer (Martin Luther University of Halle-Wittenberg, Germany), Prof. Dirk Sauerland (Witten/Herdecke University, Germany), Dr. Adela Zabalegui (Fundació Privada Clínic per la Recerca Biomèdica, Spain), Prof. Dr. Ingalill R. Hallberg (Lunds Universitet, Sweden), Prof. Dr. Jan Hamers (Maastricht University, The Netherlands), Prof. Dr. Kai Saks (University of Tartu, Estonia), Prof. Dr. David Challis (University of Nottinhgam, UK), Dr. Maria Soto Martin (Gérontôpole, University of Toulouse, France), and Prof. Dr. Helena Leino-Kilpi (University of Turku, Finland). The authors also thanks Zuzana Jiraskova for research assistance. Furthermore, the authors acknowledge the support of the study participants.

1. Introduction

Dementia is characterized by the progressive decline of cognitive, functional, and mental abilities beyond what can be expected from normal biological aging (Chandra, Coile, & Mommaerts, 2023; Jönsson, Tate, Frisell, & Wimo, 2023). As the disease progresses, affected individuals become increasingly impaired in orientation and the independent performance of everyday tasks, ultimately rendering them dependent on support. Studies have established a robust association between dementia severity and caregiving intensity, showing that advancing disease stages are associated with increasing care demands (Heger & Korfhage, 2020; Heitmueller, 2007; Van Houtven, Coe, & Skira, 2013).

Due to demographic changes and an aging population, the prevalence of dementia is projected to rise substantially in the coming decades (Jönsson et al., 2023; Livingston et al., 2024; Vilaplana-Prieto & Oliva-Moreno, 2025). This projected growth will considerably intensify the demand for care and support. Increasing care demand coincides with a shrinking formal care workforce. Consequently, the reliance on and importance of informal caregivers (IC) is substantially increasing (Steenfeldt, Aagerup, Jacobsen, & Skjødt, 2021).

IC are individuals who provide unpaid, continuous assistance with activities of daily living to persons with whom they have established social relationships (Plöthner, Schmidt, De Jong, Zeidler, & Damm, 2019). Typically, these caregivers are family members, friends or relatives (Chandra et al., 2023). They provide non-professional services designed to help these individuals to perform the basic and instrumental activities of daily life (Vilaplana-Prieto & Oliva-Moreno, 2025). Informal caregiving offers advantages for both patient with dementia (PwD) and their IC. For PwD, care provided by familiar individuals ensures emotional security and continuity, which may delay institutionalization (Pelucio, Dourado, Quagliato, & Nardi, 2023; Remers et al., 2023; Steenfeldt et al., 2021). Regarding IC, the role can foster closer relationships, a sense of meaningful contribution and financial savings (Lloyd, Patterson, & Muers, 2016; Shim et al., 2021; Steenfeldt et al., 2021). As dementia severity increases, caregiving responsibilities often escalate as well. Consequently, IC often have to face further reduced time availability, which may also influence their labour market behaviour.

Labour market effects warrant particular attention due to their long-lasting consequences, which extend far beyond the caregiving period and even beyond the death of the care recipient, affecting lifetime earnings and pension entitlements (Akyol & Nolan, 2025; Heger & Korfhage, 2020). From an economic perspective, examining the labour market effects of dementia severity and informal care intensity is critical for several reasons. As informal caregiving often competes with labour market participation, increased care needs may reduce labour supply, leading to income losses, reduced pension benefits, and lower chances of future employment or promotions (Chandra et al., 2023; Kolodziej, Reichert, & Schmitz, 2018; Mudrazija, 2019; Mudrazija & Aranda, 2025; Schmitz & Westphal, 2017). Beyond individual costs, reduced employment from caregiving has macroeconomic consequences, reducing government tax revenue and potentially slowing economic growth (Mudrazija & Aranda, 2025; Schmitz & Westphal, 2017; Schneider, Trukeschitz, Mühlmann, & Ponocny, 2013). Understanding these labour market dynamics is therefore essential for designing effective care and labour market policies that can mitigate the economic burden on caregivers while maintaining labour market participation in the context of demographic ageing and rising dementia prevalence.

Given these economic implications, several studies have examined the relationship between informal caregiving and labour market participation (e. g. Heitmueller 2007; Van Houtven et al. 2013; Schmitz and Westphal 2016; Kolodziej et al. 2018; Heger & Korfhage 2020; Neubert et al. 2021; Akyol and Nolan 2025). For example, Van Houtven et al. (2013) analysed longitudinal data from the Health and Retirement Study covering the period 1992-2008 in the United States. Using fixed effects models, they examined the relationship between informal caregiving and

labour market outcomes on both the extensive and intensive margins. Their findings reveal gender-specific effects: male caregivers providing personal care experience a 2.4 percentage point decrease in the likelihood of working, whereas female personal caregivers are no less likely to be working than non-caregivers. Female caregivers who remain employed reduce their work hours by 3-10 hours per week. In contrast, men's working hours show little effect from caregiving responsibilities. More recent evidence from Australia confirms and extends these findings. Akyol and Nolan (2025) used data from the 2005-2021 Household, Income and Labour Dynamics in Australia survey. They combined an event study with an instrumental variables approach, using the timing of the health shock as an instrument for caregiving. Their analysis shows that household health shocks significantly increase informal caregiving and lead to reductions in employment, including declines in hours worked and early retirement. In their analysis, weekly work hours fall by 9.7 hours.

However, these studies include all types of long-term care needs and therefore provide limited evidence on the labour market implications of informal caregiving for PwD (Chandra et al., 2023; Neubert, König, Mietzner, & Brettschneider, 2021). The impact of caregiving on decisions related to the labour market may differ for PwD because dementia caregiving is fundamentally different from other types of informal care, in several ways. Indeed, unlike many chronic conditions with episodic and stable phases, dementia entails continuous and irreversible decline, requiring progressively intensive supervision. Over time, this usually evolves from part-time assistance to round-the-clock care (Chandra et al., 2023; Ju et al., 2024; Peng & Chang, 2013; von Känel et al., 2012), making it especially difficult to reconcile with regular employment, unlike time-limited care situations. Another important difference is the focus of the care. Dementia care is not only physical care. Due to the decline of cognitive abilities, the IC have to undertake cognitive assistance, for example with financial and other care-related administrative and organizational tasks. These care activities often need to be provided at fixed times, which is a major challenge for IC who are active on the labour market. Especially for IC with fixed working hours inflexible care duties are difficult to arrange with employment demands. Furthermore, PwD often exhibit unpredictable behavioural symptoms and pose safety risks (Arvanitakis, Shah, & Bennett, 2019; Georges, Rakusa, Holtz, Fink, & Doblhammer, 2023; Winblad et al., 2016). These characteristics require substantially more intensive care and supervision. An intensive monitoring is required due to the gradual loss of communication abilities as the severity of dementia progresses (Coduras et al., 2010; Froelich et al., 2021; Ruiz-Fernández et al., 2019). These challenges in dementia care affect work capacity and may necessitate reduced working hours or withdrawal from employment.

For adjustments of employment decisions two possible strategies can be distinguished. IC may increase their labour market hours to compensate the economic burden of healthcare costs (Akyol & Nolan, 2025). Or, IC may reduce their labour market hours to dedicate more time to caregiving activities. Labour market adjustments result in immediate income losses and reduced pension benefits for IC (Heger & Korfhage, 2020; Schneider et al., 2013). They also create long-term financial repercussions including diminished pension entitlements and foregone career advancement opportunities (Kolodziej et al., 2018; Schmitz & Westphal, 2017). Do IC indeed reduce their labour market participation in response to care obligations, this would challenge the commonly held assumption that informal care represents a cost-effective solution for society (Spasova et al., 2018; Vullings et al., 2025). The empirical examination of these labour market responses forms the core objective of our study.

To the best of our knowledge, there is currently no study that explicitly addresses the impact of informal care for dementia on the labour market, taking into account the severity of dementia as a key factor in the intensity of care. This study aims to fill this gap. For the first time, it examines how informal carers of people with dementia (PwD) adapt their labour market

participation (extensive margin) and working hours (intensive margin) to the care requirements caused by the disease.

We use unique data from the multinational RightTimePlaceCare (RTPC) study. This study collected very detailed information about people with dementia and their primary informal carers in eight European countries. The data set includes a range of validated measures of dementia severity, care intensity and labour market behaviour. We use a two-stage instrumental variable approach to address the potential endogeneity of care intensity. We use the severity of dementia as an instrument for care intensity. In both the OLS and IV approaches, we find that an increase in dementia severity significantly increases care intensity and at the same time significantly reduces the labour market participation and working hours of informal carers. In the instrumental variables (IV) specifications, the effects of care intensity on labour market participation and working hours are greater.

Our contribution to the literature is to provide empirical evidence on how dementia severity of PwD effect labour market behaviour of IC. We identify the causal pathways through which informal care responsibilities influence employment decisions by using dementia severity as an exogenous instrument. Furthermore, we advance the literature by showing that dementia severity not only increases caregiving demands but also systematically constrains labour market participation and working hours, highlighting the dual role of dementia severity as both a determinant of care intensity and a driver of economic consequences. Taken together, our study contributes to provide an understanding of how the progressive nature of cognitive decline translates into concrete labour market adjustments among IC.

The remainder of this paper is organized as follows: Section two provides an overview of the dataset from the RTPC study and describes the variables of interest. In the third section the empirical analysis is described. The descriptive statistics and the regression results are presented in section four. The results, strength and limitations of the study are discussed in section four. In the final section a conclusion is drawn.

2. Data and methods

2.1. Data

We use survey data generated by the “RightTimePlaceCare” (RTPC) project. The prospective cohort study was conducted in eight European countries, including Estonia, Finland, France, Germany, the Netherlands, Spain, Sweden and the United Kingdom. Data was collected from November 2010 to April 2012. Each participant was questioned twice during that period, with three months between each interview. We can only use information from the first wave as important variables like the dementia severity was not included in the follow up. The dataset provides a wide range of valid behaviour measured for both PwD (e. g. dementia severity) and IC (e. g. caregiving intensity and labour market behaviour). This allows us to measure and link care giving intensity and labour market behaviour. The RTPC project comprised several inclusion criteria (1) a formal dementia diagnosis established by a qualified healthcare professional (e. g. physician, psychiatrist, neurologist, geriatrician, or general practitioner, depending on country-specific diagnostic procedures; (2) a Mini-Mental State Examination (MMSE) score of 24 or below; (3) the availability of an IC with a minimum of two visits per months and (4) a minimum age of 65 years (Verbeek et al., 2012). A detailed description of this data is available in (Bremer et al., 2015; Verbeek et al., 2012).

2.2. Sample

Our sample includes all IC in the working age population who provide care for PwD in homecare setting. The age ranges are defined according to the country-specified statutory retirement ages presented in Appendix A1. Only individuals within these age thresholds and

with complete information on all relevant variables are included in the analysis. The analytical sample comprises 461 IC.

2.3. Variables

Labour market behaviour. The main outcome variables in the analysis are (1) the labour market participation and (2) the labour market hours. To measure that we use the Resource Utilization in Dementia questionnaire (RUD) (Wimo, Jonsson, & Zbrozek, 2010). For the extensive margin we distinguish between working and non-working individuals. Individuals are classified as working if they engage in any form of paid employment, including those who provide ten or more hours per week of paid caregiving. This threshold was selected because several studies shows that ten or more hours of informal caregiving is defined as "high-intensity" care (Brimblecombe & Cartagena Farias, 2022; Carr et al., 2018; King & Pickard, 2013). We argue that this intensity is similar to formal caregiving. In contrast, non-working individuals are those who do not engage in any paid work, including those who provide fewer than ten hours per week of paid informal care. We classify individuals with labour market activity as one, and those without paid working hours as zero. For the intensive margin (2) we examine the usual number of hours worked per week among workers. We apply a log(1+hours) transformation to address right-skewness in the distribution and to reduce heteroskedasticity in the error terms (Manning & Mullahy, 2001).

Dementia severity. Our study explicitly differentiates by dementia severity through control for the MMSE score. In routine clinical practice, the MMSE is employed by physicians to aid in dementia diagnosis and assess cognitive impairment severity (Froelich et al., 2021). The test assesses temporal and spatial orientation, short-term memory, language abilities, arithmetic skills, and coordination. Scores range from 0 to 30, with lower values indicating greater cognitive impairment (Stern et al., 1994). Empirical evidence suggests that the severity is a key determinant of informal caregiving (Heger & Korfhage, 2020; Heitmueller, 2007; Van Houtven et al., 2013). For the descriptive statistics (Table 1), dementia severity was divided into two groups: a high severity of dementia was defined as a MMSE score of ≤ 15, and low severity for > 15. The cutoff was used because it represented the median. In further analysis, the severity was included as continuous variable.

Caregiving intensity in hours. The caregiving intensity was measured by the total numbers of hours per day caregivers spent on assisting their relatives. It reflects care provided with activities of daily living (ADLs) (e. g. personal hygiene, eating, and mobility), as well as instrumental activities of daily living (IADLs) (e. g. shopping, household management). The time spent by informal caregiving was measured in the RUD. IC reported the average number of hours per day they spent on ADL- and IADL-related caregiving tasks over the past 30 days. In all analysis, caregiving intensity was included as continuous variable. We follow Wübker et al. (2015) and assume a maximum of 16 caregiving hours per day with a minimum of 8 hours non-caregiving time, including sleeping time (Wübker et al., 2015).

Controls. Previous studies have shown that socio-demographic characteristics (e. g. gender, age), health-related factors (e. g. psychological wellbeing) and care-related variables (e. g. quality of care, use of formal care) can potentially affect caregiving intensity as well as labour market behaviour (Akyol & Nolan, 2025; Bremer et al., 2015; Farré et al., 2018; Heitmueller, 2007; Van Houtven et al., 2013). To account for these possible effects, we included socio-demographic characteristics in our main regression. Other control variables like health-related factors of informal caregivers are excluded in our main regression. As they are potentially directly affected by dementia severity, they could be considered 'bad controls' (Cinelli, Forney, & Pearl, 2024). Additional regressions with all control variables are reported in the

Appendix A5. Furthermore, country dummies are included in our main regressions for controlling country-specific characteristics. England was used as the reference category. Table 1 reports a description of the variables used in the empirical analysis.

Table 1 Variable description

Variable	Description
Dependent variables	
Labour market	(1,0) if Informal Caregiver (IC) is participating in the labour market
Labour market hours	IC's labour market hours per week
Labour market hours (log)	IC's logarithm of working hours per week
Independent variables	
MMSE	Mini-Mental Status Examination Value of the Patient with Dementia (PwD); Score: 0 - 30
Male IC	(1,0) if IC is male
Married IC	(1,0) if IC is married
Age IC	Age of IC
Children IC	Number of children of IC
Parent Child Relation	(1,0) if parent child relationship between informal caregiver and patient with dementia
Age PwD	Age of patient with dementia
Not living alone	(1,0) if patient with dementia is living alone
Education PwD	Years of formal education of the patient with dementia
Alzheimer	(1,0) if PwD has been diagnosed with Alzheimer
Health IC	EuroQol-5 Dimension-3 Level (EQ-5D-3L); Score: 0 - 100
Psychological wellbeing IC	General Health Questionnaire 12 (GHQ-12); Score: 0 - 36
Quality of care PwD	Client Interview Instrument (CLINT) from the perspective of the patient with dementia; Score: 9 - 45
Use formal care	(1,0) if informal caregiver uses formal care for caregiving activities
Caregiving intensity	
Informal care hours per day	Hours of informal care (ADL + IADL) per day
ADL hours	Hours of ADL per day
IADL hours	Hours of IADL per day

Note: This table reports the variable definitions. The dependent variables of this study are the binary variable of labour market participation and the logarithm of labour market hours. Explanatory variables are the severity of dementia and other social-demographic variables in the baseline model. Further control variables are added in alternative specifications. The underlined score represents the best possible score. Abbreviation = IC: Informal caregiver, PwD: Patient with dementia, ADL: Activities of daily living, IADL: Instrumental Activities of daily living.

2.4. Empirical strategy

First, the mean values and standard deviations of the variables are presented for two categories of dementia severity (low and high) as well as for the overall pooled data. To assess the differences between the mean values of the groups, we calculated Cohen´s d as a standardised effect size measure for each variable. This provides us insights into which variables are balanced across dementia severity levels and which variables exhibit substantial variation across dementia severity levels (Table 2).

Second, in our baseline model we assess in a first step the impact of dementia severity on labour market outcomes using multivariate regression models. Equation 1 shows the general regression equation form estimated by ordinary least square (OLS):

$$Y_{IC} = ß_0 + ß_1 Z_{PwD} + ß_2 X_{IC} + ß_3 X_{PwD} + ß_4 C_{IC} + v_{IC} \quad (1)$$

where Y_{IC} captures the labor market outcomes of IC. The dependent variables are (1) labour force participation and (2) the logarithm of weekly working hours. The coefficient $ß_1$ is the parameter of interest and captures the influence of the severity of dementia of PwD on the

labour market outcomes of caregivers. X_{IC} and X_{PwD} are vectors of sociodemographic control variables for IC and PwD, respectively, while IC refers to country fixed effects (C_{IC}). Results are considered significant at the 5% level.

In a second step we use a further specification to focus on the impact of informal caregiving on labour market outcomes. Several studies have mentioned endogeneity concerns that could be bias the labour market behaviour in the OLS (Bergeot & Fontaine, 2020; He & McHenry, 2013; Heitmueller, 2007; Van Houtven et al., 2013). One concern is the possibility of reverse causality (He & McHenry, 2013; Heitmueller, 2007). Individuals with weaker labour market outcomes, e. g. unemployment or part-time work, may be more likely to assume caregiving responsibilities due to greater availability. Furthermore, individuals with strong family bonds are more likely to provide care. Therefore, individuals do not randomly become informal caregivers (selection effects). Another concern is the omitted variable bias (He & McHenry, 2013; Zhu & Onur, 2023). Unobserved factors such as family wealth or the availability of other informal caregivers may simultaneously influence both the likelihood of informal care intensity and labour market outcomes. To mitigate these endogeneity concerns, we performed further analysis using a 2SLS IV. In our IV strategy, the severity of dementia is used as an instrument for informal care hours. Instrumenting informal care intensity with the severity of dementia helps to reduced bias caused by measurement errors (He & McHenry, 2013). In the RUD the informal caregiving hours are self-reported and prone to recall boas and rounding errors. The severity of dementia, measured with the MMSE is less affected by individual reporting.

Equation 2 shows the first stage regression of the 2SLS IV:

First stage

$$D_{IC} = \alpha_0 + \alpha_1 Z_{PwD} + \alpha_2 X_{IC} + \alpha_3 X_{PwD} + \alpha_4 C_{IC} + v_{IC} \quad (2)$$

where D_{IC} denotes the intensity of caregiving in hours provided by IC. The coefficient α_1 represents is the parameter of interest and measures the effect of dementia severity on caregiving intensity. The vectors X_{IC} and X_{PwD} include socio-demographic variables of IC and PwD. C_{IC} accounts for country fixed effects. A 5% significance threshold is applied.

For the second stage we include the predicted value of caregiving intensity per day ($\widehat{D_{IC}}$) from the first stage in the second stage regression. The equation is as follows:

Second Stage

$$Y_{IC} = \gamma_0 + \gamma_1 \widehat{D_{PwD}} + \gamma_2 X_{IC} + \gamma_3 X_{PwD} + \gamma_4 C_{IC} + e_{IC} \quad (3)$$

where Y_{IC} describes the labour market behaviour (intensive and extensive margin) of each IC. The coefficient of interest is γ_1, which captures the effect of informal caregiving intensity on labour market outcomes. All other notations in this equation are the same as in the previous equation.

For a valid instrument variable two conditions must be satisfied. First the relevance condition: dementia severity is strongly correlated with caregiving intensity. Prior research consistently identifies dementia severity as one of the main determinants of informal caregiving. A higher severity of dementia is associated with higher caregiving intensity (Heger & Korfhage, 2020; Heitmueller, 2007; Van Houtven et al., 2013). Second the exclusion restriction must be fulfilled. Dementia severity must affect labour market behaviour only through informal caregiving. We argue that dementia severity does not directly affect labour market behaviour; instead, any decrease in labour market participation arises from the caregiving obligations associated with the illness. To mitigate concerns about potential indirect pathways, such as the Parent-Child

Relation, the health status of the IC or the use of formal care, we control for these factors within a sensitivity analysis (see Appendix A5).

We use the Durbin-Wu-Hausman test (DWH) to assess the potential endogeneity of the intensity of informal care. With this test, we examine the null hypothesis that the hours of informal care are exogenous. In this case, OLS estimates would be consistent. In contrast, rejection of the null hypothesis would indicate endogeneity and justify the use of an IV approach (Heitmueller, 2007). We also assess the relevance of the instrument in order to allay concerns about weak instruments. Following Staiger and Stock (1997), we rely on the first-stage F-statistic: first-stage values above 10 indicate sufficient instrument strength. In our analysis, the first-stage F-statistic is 31.12. This value indicates that the instrument correlates strongly with the intensity of informal care. To check the robustness of our results we use a probit model for the extensive, and a negative binomial distribution for the intensive margin.

3. Results

3.1. Descriptive analysis

Table 2 presents the baseline characteristics of the study sample, differentiated by two categories of dementia severity (low and high). Mean and standard deviations are shown for the whole sample and for each dementia severity separately.

In the total sample the IC demonstrated a mean labour market participation of 66% (Standard deviation: 0.47) and worked an average of 23.45 (20.21) hours per week. Nearly one-third of the total IC were male (0.29 (0.45)), 66% (0.47) were married, and the mean age was 53.39 (7.40) years. Most of the IC were in a Parent-Child-relationship to the PwD (0.80 (0.40)). The PwD had a mean age of 82.91 (6.12) years, with half of them not living alone (51% (0.50)), an average of 8.54 (3.68) years of education, and a diagnosis of Alzheimer's disease (55% (0.50)). Regarding health-related variables, IC reported a mean self-rated health score of 80% (0.25) and psychological wellbeing score of 12.98 (5.85). Care-related variables showed a mean care quality score of 15.42 (5.14) and a small proportion using formal care services (9% (0.29)). IC provided an average of 4.54 (4.32) hours of informal care per day, comprising 2.00 (2.75) hours for ADL and 2.54 (2.13) hours for IADL. Regarding the behaviour of interest, the following patterns were observed: a high severity of dementia is associated with a small labour market participation (0.63 (0.48)), less labour market hours per week (21.97 (20.20)) and higher informal care hours per day (5.93 (4.88)). In contrast, we observe a higher labour market participation (0.46 (0.15)), more labour market hours per week (25.05 (20.14)) and less informal care hours per day (3.09 (3.03)) when focusing of PwD with a low dementia severity score.

Table 2 Descriptive statistics

	All (N = 461)		High severity of dementia (N = 236)		Low severity of dementia (N = 225)		Std. Diff.
	Mean	SD	Mean	SD	Mean	SD	
Dependent variables							
Labour market	0.66	0.47	0.63	0.48	0.70	0.46	0.15
Labour market hours	23.47	20.21	21.97	20.20	25.05	20.14	0.15
Log labour market hours	2.29	1.74	2.16	1.77	2.43	1.70	0.16
Independent variables							
MMSE	14.61	6.64	9.32	4.81	20.15	2.43	2.82
Socio-demographic variables							
Male IC	0.29	0.45	0.27	0.45	0.31	0.46	0.09
Married IC	0.66	0.47	0.63	0.48	0.69	0.46	0.14
Age IC	53.39	7.40	52.83	7.98	53.98	6.72	0.16
Children IC	0.36	0.73	0.34	0.71	0.39	0.75	0.07

Parent Child Relation	0.80	0.40	0.77	0.42	0.84	0.37	0.17
Age PwD	82.91	6.12	82.86	6.66	82.97	5.52	0.02
Not living alone	0.51	0.50	0.64	0.48	0.36	0.48	0.57
Education PwD	8.54	3.68	8.40	3.51	8.70	3.86	0.08
Alzheimer	0.55	0.50	0.50	0.50	0.61	0.49	0.22
Health-related variables							
Health IC	0.80	0.25	0.76	0.26	0.83	0.23	0.27
Psychological wellbeing IC	12.98	5.85	13.54	6.08	12.40	5.56	0.20
Care-related variables							
Quality of Care PwD	15.42	5.14	15.03	4.90	15.83	5.35	0.16
Use formal care	0.09	0.29	0.10	0.30	0.08	0.27	0.08
Caregiving intensity							
Informal care hours per day	4.54	4.32	5.93	4.88	3.09	3.03	0.70
ADL hours per day	2.00	2.75	2.89	3.15	1.07	1.84	0.70
IADL hours per day	2.54	2.13	3.04	2.34	2.02	1.74	0.49

Note: The table presents descriptive statistics of PwD and IC characteristics, differentiating between the group of PwD with high and the group of PwD with low dementia severity. High severity illustrates MMSE score value from 0-15, low severity from 16-30. Column 1 to 6 reports descriptive statistics, while the seventh column reports the standard differences between the two groups. Abbreviation: IC: Informal caregiver, PwD: Patient with dementia, MMSE: Mini-Mental State Examination, ADL: Activities of daily living, IADL: Instrumental activities of daily living, SD: Standard deviation; Std. Diff.: Values around 0.2, 0.5, and 0.8 indicate small, medium, and large differences.

3.2. Effects of dementia severity on labour market behaviour

Table 3 presents the effects of dementia severity on labour market behaviour. Column (1) shows the results for the labour market participations, incorporating the socio-demographic and country dummies. Column (2) shows the results of the second dependent variable: the logarithm of the labour market hours with the same control variables as column (1).

Our primary focus is on the MMSE score, which represents the dementia severity. In column (1), the coefficient is 0.007, significant on a 5% level with a standard error of 0.004. This suggests that an additional score value of the MMSE, which indicates a greater cognitive impairment, leads to approximately 0.7 percentage points increase in the likelihood of labour market participation. The estimation in column (2) implies that an additional score value of the MMSE leads to a 2.7% increase in labour market hours. This result is significant on the 5% level. The standard error is 0.013.

Table 3 Dementia Severity on Labour Market Outcomes

	(1) Labour market participation	(2) Labour market hours (log)
MMSE	0.007**	0.027**
	(0.004)	(0.013)
Male IC	-0.040	-0.076
	(0.048)	(0.177)
Married IC	-0.007	0.038
	(0.047)	(0.177)
Age IC	-0.012***	-0.044***
	(0.004)	(0.014)
Children IC	-0.004	-0.071
	(0.033)	(0.117)
Age PwD	-0.003	-0.006
	(0.004)	(0.014)
Education PwD	0.007	0.026
	(0.006)	(0.023)

Parent Child Relation	0.217***	0.805***
	(0.059)	(0.213)
Not living alone	-0.029	-0.089
	(0.053)	(0.194)
Alzheimer	0.043	0.112
	(0.053)	(0.193)
Sweden	0.121	0.415
	(0.112)	(0.422)
Estonia	-0.023	-0.056
	(0.106)	(0.387)
France	-0.101	-0.250
	(0.117)	(0.423)
Finland	-0.189	-0.524
	(0.120)	(0.437)
Netherlands	-0.118	-0.589
	(0.113)	(0.407)
Germany	-0.048	-0.137
	(0.115)	(0.412)
Spain	-0.033	-0.079
	(0.120)	(0.450)
Constant	1.284***	4.056***
	(0.348)	(1.291)
Observations	461	461
R^2	0.113	0.101

Note: Table 3 reports our OLS analysis. Dependent variables are the binary variable of labour market participation and the logarithm of labour market hours. The analysis reveals a positive association from dementia severity (MMSE) and labour market behaviour. Indication that a higher MMSE score (lower dementia severity) is associated with a higher labour market participation and labour market hours. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

As a robustness check, we estimate alternative model specifications to verify the consistency of our findings. Specifically, we employed a probit model for labour market participation and a negative binomial regression model for labour market hours, which are presented in Appendix A2. The results from these alternative specifications are consistent with our main findings[1].

3.3. Effects of care intensity on labour market behaviour

Table 4 shows the effects of care intensity in hours per day on labour market behaviour. The OLS results are shown in column (1) for labour market participation and in column (3) for the logarithm of labour market hours. In column (2) and (4) the 2SLS IV approach is presented.

When we focus on the informal care hours per day, we observe a significant negative effect across all models. For labour market participation, the coefficient of the OLS model is -0.015, significant on the 5% level with a standard error of 0.006 (column (1)). This indicates that an increase of one informal care hour per day leads to a decrease of the likelihood for labour market participations of approximately 1.5 percentage points. In comparison the 2SLS IV models suggest a decrease of the likelihood of approximately 4.3 percentage points.

The logarithm of the labour market hours presents similar findings. The OLS results in column (3) indicate that an increase of one additional informal care hour per day leads to an

[1] The average margin effects of the probit model for the extensive margin shows a similar result to the OLS (0.007 ($p < 0.05$)). For the intensive margin we use a negative binominal regression with log-link specification confirms the positive association between dementia severity and labour market hours, with a semi-elasticity of 1.9% ($p < 0.05$).

approximate decrease of 5.9% in labour market hours ($p < 0.01$). In column (4) a decrease of approximately 16.3% can be observed ($p < 0.05$).

Overall, we can demonstrate that the estimated impact of informal care increases when the effects of endogeneity are considered. This applies to both the extensive and the intensive margin.

The DWH test statistics reported in Table 4 (p-values of 0.206 and 0.200) indicate that the null hypothesis of exogeneity cannot be rejected. This suggest that the difference of the OLS and IV coefficients are not statistically significant and thus endogeneity is not empirically supported. The first-stage regression results are reported in the Appendix A4 and confirm the relevance of the instrument, as indicated by the significant first-stage F-test of 29.942 (Table 4).

Table 4 Informal Care on Labour Market Behaviour

	(1)		(2)	
	Labour market participation		Labour market hours (log)	
	OLS	IV 2SLS	OLS	IV 2SLS
Informal care hours per day	-0.015**	-0.043**	-0.059***	-0.163**
	(0.006)	(0.021)	(0.022)	(0.077)
Male IC	-0.051	-0.073	-0.123	-0.204
	(0.048)	(0.052)	(0.176)	(0.187)
Married IC	-0.012	-0.020	0.020	-0.012
	(0.047)	(0.048)	(0.176)	(0.178)
Age IC	-0.012***	-0.012***	-0.043***	-0.042***
	(0.004)	(0.004)	(0.014)	(0.014)
Children IC	-0.012	-0.027	-0.104	-0.161
	(0.033)	(0.035)	(0.117)	(0.124)
Age PwD	-0.003	-0.003	-0.006	-0.007
	(0.004)	(0.004)	(0.014)	(0.014)
Parent Child Relation	0.215***	0.212***	0.798***	0.786***
	(0.058)	(0.058)	(0.211)	(0.211)
Education PwD	0.007	0.007	0.027	0.028
	(0.006)	(0.006)	(0.023)	(0.023)
Not living alone	-0.006	0.037	0.002	0.161
	(0.054)	(0.066)	(0.197)	(0.239)
Alzheimer	0.028	-0.002	0.051	-0.058
	(0.054)	(0.056)	(0.194)	(0.204)
Sweden	0.091	0.033	0.294	0.082
	(0.114)	(0.128)	(0.425)	(0.470)
Estonia	-0.006	0.026	0.011	0.129
	(0.106)	(0.114)	(0.379)	(0.397)
France	-0.106	-0.116	-0.271	-0.307
	(0.118)	(0.124)	(0.425)	(0.438)
Finland	-0.195	-0.207*	-0.549	-0.592
	(0.121)	(0.125)	(0.436)	(0.444)
Netherlands	-0.143	-0.191	-0.689*	-0.865**
	(0.115)	(0.123)	(0.409)	(0.436)
Germany	-0.059	-0.081	-0.182	-0.262
	(0.114)	(0.116)	(0.407)	(0.404)
Spain	-0.011	0.031	0.008	0.161
	(0.120)	(0.124)	(0.444)	(0.452)
MMSE	0.005		0.017	
	(0.004)		(0.013)	
Constant	1.400***	1.616***	4.510***	5.307***
	(0.348)	(0.359)	(1.286)	(1.331)
Observations	461	461	461	461
R^2	0.126		0.115	
Partial R^2		0.070		0.070
Durbin–Wu–Hausman Test		1.602 (0.206)		1.647 (0.200)

First-stage F-Test	29.942***	29.942***

Note: Table 4 reports our OLS and 2SLS IV estimates as in equations (1) and (3). The instrument of the 2SLS IV is dementia severity (MMSE). The first-stage F-Test confirming the relevance of the instrument (rule of thumb: F > 10 indicates strong instrument (Staiger & Stock, 1997)). Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

As sensitivity analysis, we address the binary and count nature of our dependent variable. To this aim we estimate probit and negative binomial models, as these models might capture better the functional form of the data than OLS (Appendix A2). The results from these alternative specifications are consistent with our OLS estimates. The average marginal effects of the probit model for the extensive margin shows a coefficient of -0.016 ($p < 0.01$), closely aligning with the OLS estimate of -0.015 ($p < 0.05$) and confirming the negative relationship between informal care hours and labour market participation. For the intensive margin, the negative binomial regression with log-link specification yields a semi-elasticity of -3.9% ($p < 0.01$), which is more conservative than the OLS estimate of 5.9 ($p < 0.05$) but remains statistically significant and confirms the negative association between informal care intensity and working hours.

Further, we account for potential indirect pathways, by adding health- and care-related variables to our baseline specification. The results of our variable of interest remain robust across both the OLS and the IV approach. Informal care intensity per day has a negative and statistically significant effect on the extensive and intensive margin. Moreover, the DWH test (p-value = 0.234/0.205) provides no statistical evidence of endogeneity, while the first-stage F-statistic (30.984) confirms the relevance of the instrument. The detailed results are reported in the Appendix A5.

4. Discussion

This paper investigates the impact of dementia severity on labour market participation of IC using European data from the RTPC study. We begin our analysis by examining the effect of dementia severity on labour market participation (extensive margin) and labour market hours (intensive margin) using OLS regression. We found a positive correlation between the dementia severity, measured by the MMSE, and labour market behaviour. One additional score in the MMSE score (meaning lower dementia severity) is associated with a 7.3 percentage point higher likelihood to participate on the labour market (extensive margin). The number of labour market hours increases by 2.9% with each additional MMSE score.

Next, we predict informal caregiving hours using the MMSE score. To address potential endogeneity, we use an 2SLS IV approach. The results show a significant negative effect of informal caregiving hours on both extensive and intensive margins. The IV results show that one additional hour is associated with a 4.3 percentage point decrease in our extensive margin and a 17.2% decrease in our intensive margin. Similarly, OLS reveals also a significant negative association. One additional hour of caregiving responsibilities per day reduces the probability to work by 1.5 percentage point and the working hours by 6.1%. Although the IV estimates are significantly larger than the OLS coefficients, the null hypothesis of exogeneity of the coefficient is not rejected by the DWH test. This result suggests that the OLS estimates are consistent. Therefore, the IV results should be interpreted as robustness checks and as potential upper-bound estimates of the impact of informal care on the labour market. The consistency of the coefficients in terms of sign and significance between the OLS and IV specifications underscores the robustness of our results overall. The robustness checks using alternative specifications yield consistent results when changing the statistical methods, adding several control variables, or including active individuals beyond the country-specific retirement age. Overall, these findings suggest that labour market behaviour among IC is significantly

influenced by caregiving responsibilities, which are themselves directly affected by the dementia severity.

Our findings are consistent with previous studies showing that informal caregiving has a negative impact on labour market outcomes (Akyol & Nolan, 2025; Heitmueller, 2007; Kolodziej et al., 2018; Lilly, Laporte, & Coyte, 2010; Schmitz & Westphal, 2017; Van Houtven et al., 2013). Van Houtven et al. (2013) found a 2.4 percentage point decrease in the likelihood of labour market participation for male caregivers, while Kolodziej et al. (2018) reported a decrease of 14 percentage points. Our IV results of 4.3 percentage points fall between these estimates. One possible explanation is that patients with dementia in our sample have on average a dementia severity of 14.61 and therefore face a risk of institutionalization. The intensity of care may be higher than in Van Houtven et al. (2013), who examined general caregiving, but lower than in Kolodziej et al. (2018), who focused on daily intensive care provision. Another explanation relates to the study period.

Focusing on labour market hours, our results show a reduction of 6.3 hours (OLS) and 17.4 hours (IV) per week at the sample mean of 23.47 working hours per week. Van Houtven et al. (2013) found a smaller reduction of 3-10 hours per week for female caregivers. The IV results of Akyol et al. (2025) indicate a weekly reduction of 9.68 hours for the main carer, which is also lower than our IV estimate. The larger effects in our study reflect the specific demands of dementia care. Dementia caregiving requires continuous care and attention, particularly as cognitive decline progresses, leading to higher caregiving intensity and consequently greater impact on labour market hours compared to general caregiving.

Overall, our results fundamentally challenge the policy assumptions regarding the cost-effectiveness of informal care. Different studies argue that ageing-in-place with community-based care is less expensive than institutionalized care (Bergeot & Fontaine, 2020; Spasova et al., 2018; Vullings et al., 2025). Yet our findings demonstrate that informal caregiving substantially reduces labour market participation and working hours. These labour market reductions translate into productivity losses and long-term loss of income, increasing the true societal costs of informal care. When these costs are accurately considered, informal care may no longer represent a cost-effective solution. Critically, previous studies show that the labour market consequences often outlast the care recipient's lifetime, creating lasting economic disadvantages for informal caregivers (Chandra et al., 2023; Heger & Korfhage, 2020; Schneider et al., 2013; Van Houtven et al., 2013). Schmitz and Westphal (2017), for example, followed German women for eight years after their caregiving experience and found persistent employment disadvantages and income losses that that diminished only gradually over time (Heger & Korfhage, 2020; Schmitz & Westphal, 2017). When considering care reforms, policymakers should take into account the influence of informal care on labour market behaviour (He & McHenry, 2013; Lilly et al., 2010).

This study has several strengths and limitations that should be considered when interpreting the findings. The primary strengths include the comprehensive dataset, which uniquely combines information on PwD, disease severity, informal caregiving intensity, and labour market behaviour. Moreover, a range of validated measures was used, improving the reliability and comparability of our results. The multinational European data covering eight countries further enhances external validity and enables cross-national comparisons of health system responses to dementia care in Europe. Nevertheless, several limitations must be acknowledged. First, self-reported questionnaires introduce potential recall and social desirability bias, particularly regarding caregiving responsibilities and work behaviour. Second, data was collected between 2010 and 2012, which raises questions about the contemporary validity. Considering the rising prevalence of dementia, we argue that our results likely underestimate the current effects of dementia caregiving on labour market outcomes. However, the unique and

comprehensive nature of the RTPC data provides valuable insights into the relationship between dementia severity and labour market participation, which remains relevant for understanding these dynamics. Third, due to the cross-sectional nature of data, the analysis of dynamic and long-term effects is not possible with our design and would be the subject of future research.

Finally, the external validity of our findings is limited, as we focus on IC of PwD who are at significant risk of institutionalisation, reflecting the inclusion criteria of the RTPC. Although this focus limits the conclusions to a specific subgroup of dementia patients, it is precisely for this group that the care requirements are high and the relevance for labour market decisions is pronounced, making the analysis of the impact on employment particularly relevant from both an economic and a political perspective.

5. Conclusion

Our study has shown that the severity of dementia significantly impacts the intensity of care and the labour market behaviour of informal caregivers. Given population ageing trends, there is an urgent need to optimally support IC of PwD, enabling them to effectively balance both their caregiving responsibilities and labour market behaviour. Follow-up scientific work might consider these (or similar) findings in their analyses. For instance, economic evaluations of informal dementia care (e. g. cost analyses) could consider the labour market impact of informal caregiving - by diseases severity - when calculating the indirect and opportunity costs of care.

Funding

The authors have nothing to report.

Conflict of Interest

The authors declare no conflict of interest.

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Appendices

Appendix A1

Table A1 Eligibility ages for statutory retirement benefits, Men (Women)

	England	Estonia	Finland	France	Germany	Netherlands	Spain	Sweden
2010	65 (60)	63 (61)	65	60	65	65	65	65
2011	65 (60)	63 (61.5)	65	60	65	65	65	65
2012	65 (60)	63 (61.5)	65	60-62	65.08	65	65	65

Source: MISSOC (2015); Note: Eligibility ages with greatest incentives to retire; France: as from 01 January 2012 normal retirement age increases by five months per birth year to reach 62 for persons born in 1955 or later.

Appendix A2

Table A2 Dementia Severity on Labour Market Behaviour – Alternative Specification

	(1)	(2)	
	Labour market participation	Labour market hours	
	Probit AME	Neg. Bin.	Neg. Bin. AME
MMSE	0.007**	0.019**	0.448**
	(0.003)	(0.007)	(0.176)
Male IC	-0.040	-0.026	-0.621
	(0.045)	(0.101)	(2.381)
Married IC	-0.010	0.005	0.108
	(0.046)	(0.098)	(2.315)
Age IC	-0.012***	-0.031***	-0.729***
	(0.004)	(0.010)	(0.232)
Children IC	-0.003	-0.083	-1.958
	(0.035)	(0.061)	(1.457)
Age PwD	-0.003	0.004	0.086
	(0.004)	(0.010)	(0.229)
Education PwD	0.008	0.010	0.231
	(0.006)	(0.014)	(0.321)
Parent Child Relation	0.209***	0.454***	10.755***
	(0.052)	(0.136)	(3.207)
Not living alone	-0.028	-0.099	-2.341
	(0.051)	(0.110)	(2.609)
Alzheimer	0.052	-0.004	-0.103
	(0.052)	(0.108)	(2.551)
Sweden	0.190	0.185	4.384
	(0.140)	(0.204)	(4.824)
Estonia	-0.021	0.056	1.331
	(0.115)	(0.204)	(4.824)
France	-0.105	-0.058	-1.380
	(0.123)	(0.220)	(5.209)
Finland	-0.178	-0.145	-3.430
	(0.123)	(0.229)	(5.418)
Netherlands	-0.116	-0.328	-7.781
	(0.118)	(0.221)	(5.227)
Germany	-0.044	-0.046	-1.086
	(0.120)	(0.214)	(5.069)
Spain	-0.021	0.214	5.077
	(0.127)	(0.246)	(5.855)
Observations	461	461	461

Note: Table 6 reports the estimates of the probit (column 1) and the negative binomial regression with log-link specification (column 2) and the average marginal effects in hours (column 3). Abbreviation: AME: average marginal effect, IC: Informal caregiver, PwD: Patient with dementia; Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix A3

Table A3 Informal care Intensity on Labour Market Behaviour – Alternative Specification

	(1) Labour market participation	(2) Labour market hours	
	Probit AME	Neg. Bin. Coef.	Neg. in. AME
Informal care hours per day	-0.016***	-0.039***	-0.931***
	(0.005)	(0.014)	(0.339)
Male IC	-0.054	-0.061	-1.440
	(0.046)	(0.102)	(2.406)
Married IC	-0.013	-0.008	-0.196
	(0.046)	(0.099)	(2.354)
Age IC	-0.012***	-0.030***	-0.709***
	(0.004)	(0.010)	(0.233)
Children IC	-0.013	-0.106*	-2.520*
	(0.035)	(0.062)	(1.486)
Age PwD	-0.004	0.001	0.020
	(0.004)	(0.010)	(0.237)
Education PwD	0.009	0.010	0.247
	(0.006)	(0.014)	(0.324)
Parent Child Relation	0.206***	0.460***	10.905***
	(0.052)	(0.137)	(3.211)
Not living alone	-0.013	-0.080	-1.893
	(0.052)	(0.113)	(2.687)
Alzheimer	0.028	-0.064	-1.521
	(0.052)	(0.107)	(2.538)
Sweden	0.163	0.145	3.434
	(0.141)	(0.201)	(4.755)
Estonia	-0.017	0.038	0.903
	(0.114)	(0.195)	(4.623)
France	-0.108	-0.022	-0.521
	(0.124)	(0.218)	(5.162)
Finland	-0.169	-0.116	-2.744
	(0.123)	(0.226)	(5.353)
Netherlands	-0.138	-0.354	-8.382
	(0.119)	(0.217)	(5.129)
Germany	-0.062	-0.082	-1.939
	(0.119)	(0.214)	(5.064)
Spain	0.019	0.316	7.477
	(0.126)	(0.245)	(5.848)
Observations	461	461	461

Note: Table 7 reports the estimates of the probit (column 1) and the negative binomial regression with log-link specification (column 2) and the average marginal effects in hours (column 3). Abbreviation: AME: average marginal effect, IC: Informal caregiver, PwD: Patient with dementia; Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix A4

Table A4 First-Stage Regressions: Effect of MMSE on Informal Care Hours

	(1) Informal Care Hours per Day
MMSE Score	-0.165***
	(0.030)
Male IC	-0.782**
	(0.350)
Married IC	-0.305
	(0.405)
Age IC	0.007
	(0.037)
Children IC	-0.552**
	(0.243)
Age PwD	-0.006
	(0.033)
Parent Child Relation	-0.115
	(0.469)
Education PwD	0.009
	(0.050)
Not living alone	1.527***
	(0.418)
Alzheimer	-1.042***
	(0.378)
Sweden	-2.036**
	(0.846)
Estonia	1.134
	(0.951)
France	-0.347
	(0.952)
Finland	-0.416
	(0.898)
Netherlands	-1.688**
	(0.843)
Germany	-0.764
	(0.922)
Spain	1.472
	(1.117)
Constant	7.657***
	(2.905)
Observations	461
R^2	0.342
Adjusted R^2	0.316
F-statistic (instrument)	29.94
F-statistic p-value	0.000

Note: Table 8 presents the first stage regression. We analyse the effect of dementia severity (MMSE) on informal care hours per day. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. F-statistic tests the relevance of MMSE as instrument (rule of thumb: F > 10 indicates strong instrument).

Appendix A5

Table A5 Robustness check

	(1)		(2)	
	Labour market participation		Labour market hours (log)	
	OLS	IV 2SLS	OLS	IV 2SLS
Informal care hours per day	-0.015**	-0.042**	-0.058***	-0.157**
	(0.006)	(0.021)	(0.023)	(0.077)
Male IC	-0.063	-0.080	-0.179	-0.240
	(0.049)	(0.050)	(0.176)	(0.179)
Married IC	-0.018	-0.028	-0.003	-0.039
	(0.047)	(0.047)	(0.174)	(0.175)
Age IC	-0.012***	-0.011***	-0.042***	-0.041***
	(0.004)	(0.004)	(0.014)	(0.014)
Children IC	-0.011	-0.025	-0.102	-0.155
	(0.032)	(0.034)	(0.114)	(0.121)
Age PwD	-0.002	-0.002	-0.003	-0.003
	(0.004)	(0.004)	(0.014)	(0.014)
Parent Child Relation	0.199***	0.189***	0.737***	0.700***
	(0.058)	(0.058)	(0.209)	(0.209)
Education PwD	0.005	0.005	0.020	0.021
	(0.006)	(0.006)	(0.023)	(0.022)
Living not alone	0.008	0.044	0.056	0.187
	(0.054)	(0.064)	(0.198)	(0.232)
Alzheimer	0.029	0.001	0.050	-0.052
	(0.053)	(0.055)	(0.191)	(0.198)
Sweden	0.077	0.028	0.241	0.064
	(0.107)	(0.119)	(0.400)	(0.434)
Estonia	0.014	0.038	0.072	0.159
	(0.099)	(0.104)	(0.356)	(0.364)
France	-0.088	-0.093	-0.196	-0.213
	(0.114)	(0.117)	(0.410)	(0.415)
Finland	-0.213*	-0.221*	-0.619	-0.649
	(0.114)	(0.117)	(0.413)	(0.414)
Netherlands	-0.148	-0.191*	-0.711*	-0.867**
	(0.109)	(0.116)	(0.388)	(0.409)
Germany	-0.052	-0.071	-0.167	-0.233
	(0.109)	(0.109)	(0.388)	(0.379)
Spain	0.035	0.069	0.167	0.290
	(0.114)	(0.116)	(0.431)	(0.428)
Health IC	0.244**	0.263***	1.027***	1.094***
	(0.100)	(0.098)	(0.364)	(0.357)
Psychological wellbeing IC	0.002	0.005	0.006	0.017
	(0.004)	(0.005)	(0.015)	(0.017)
Quality of Care PwD	-0.000	-0.001	-0.002	-0.007
	(0.004)	(0.004)	(0.015)	(0.015)
Use formal care	-0.172**	-0.158*	-0.558*	-0.507*
	(0.080)	(0.081)	(0.299)	(0.300)
Constant	1.146***	1.316***	3.482**	4.094***
	(0.377)	(0.379)	(1.375)	(1.377)
MMSE	0.005		0.016	
	(0.004)		(0.014)	
Observations	461	461	461	461
R^2	0.151		0.143	
Partial R^2		0.073		0.073
Durbin–Wu–Hausman Test		1.500 (0.221)		1.465 (0.227)
First-stage F-Test		31.407***		31.407***

Note: Table 9 presents the robustness checks of our basic model. We include further control variable regarding health-related and care related variables. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01**.**